FIG. 1

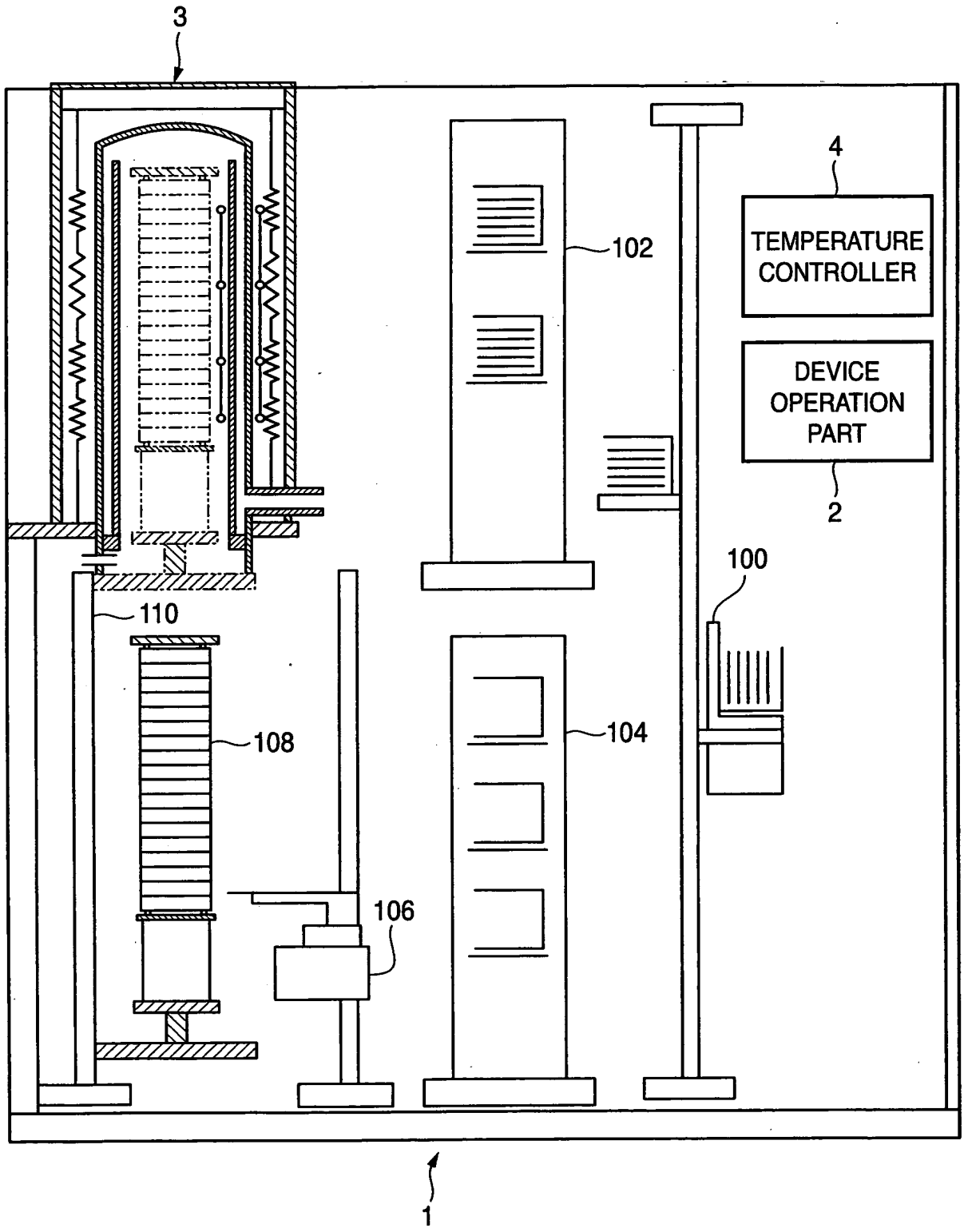
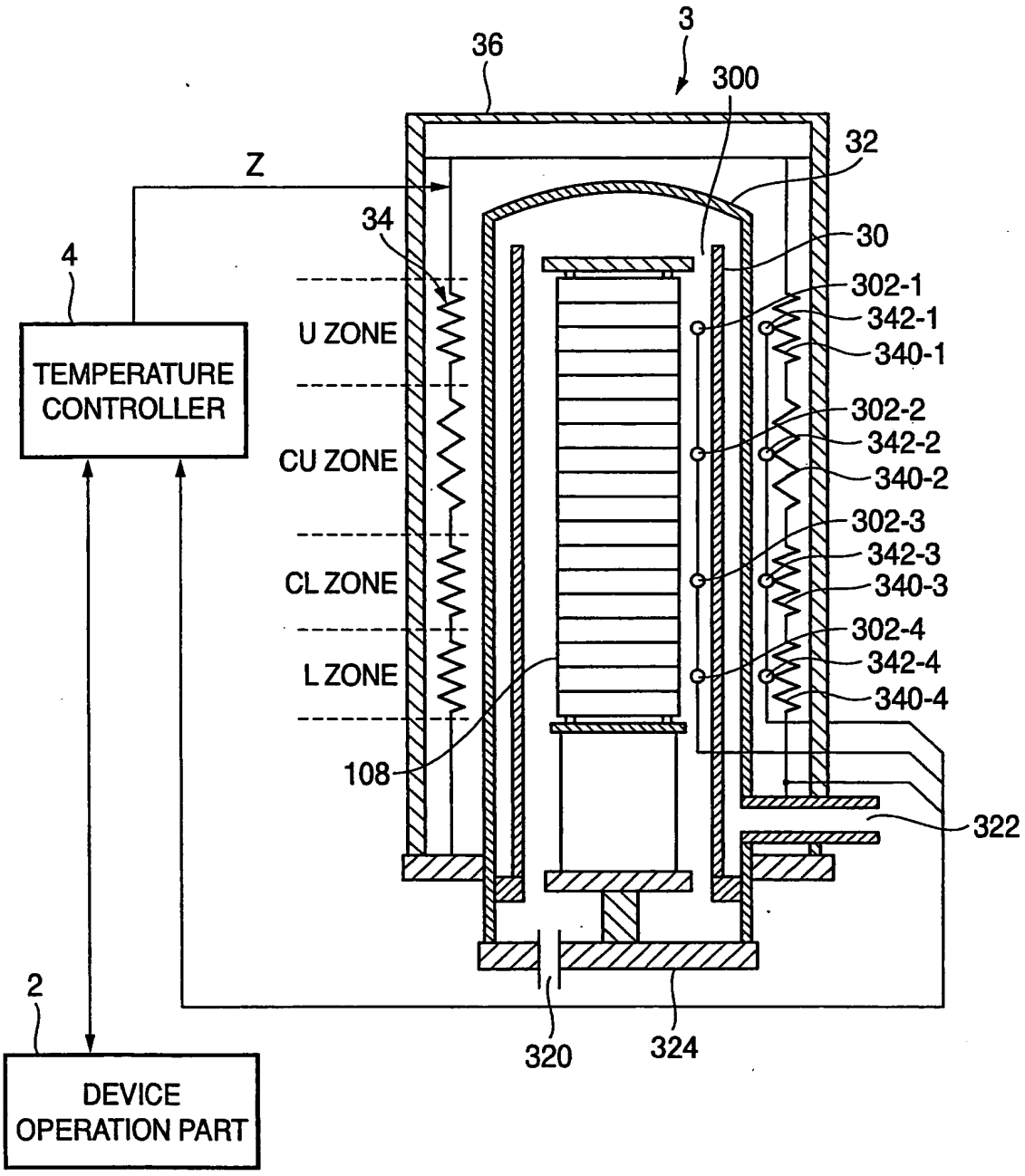

3
4
TEMPERATURE CONTROLLER
DEVICE OPERATION PART
2
102
100
110
108
104
106
1

FIG. 2


3
36
300
32
Z
34
30
4
302-1
342-1
340-1
U ZONE
TEMPERATURE CONTROLLER
302-2
342-2
CU ZONE
340-2
302-3
342-3
CL ZONE
340-3
302-4
342-4
L ZONE
340-4
108
322
2
320
324
DEVICE OPERATION PART

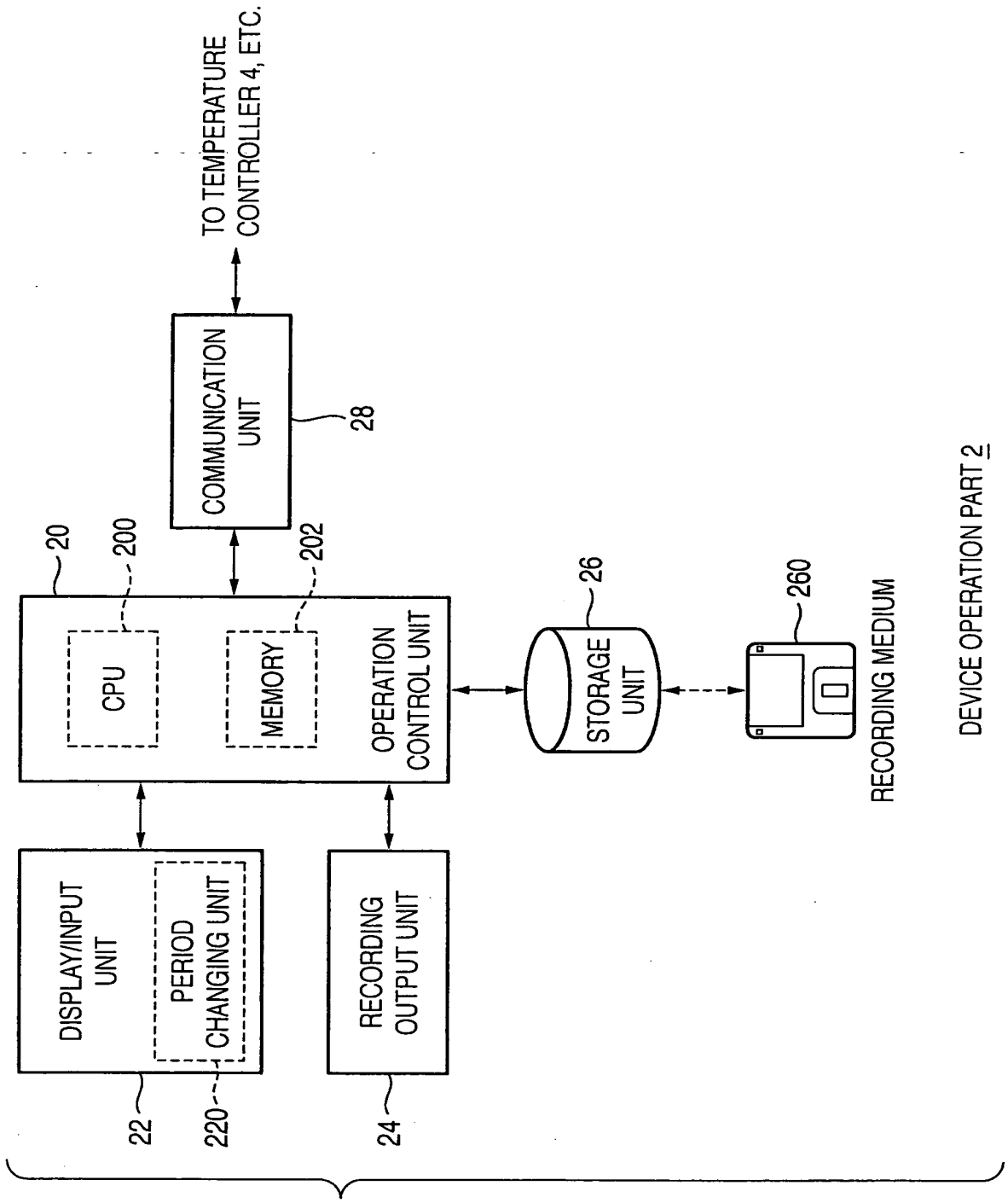

TO TEMPERATURE CONTROLLER 4, ETC.
COMMUNICATION UNIT
28
20
200
202
CPU
MEMORY
OPERATION CONTROL UNIT
26
STORAGE UNIT
260
RECORDING MEDIUM
DEVICE OPERATION PART 2
DISPLAY/INPUT UNIT
PERIOD CHANGING UNIT
RECORDING OUTPUT UNIT
22
220
24

FIG. 3

FIG. 4

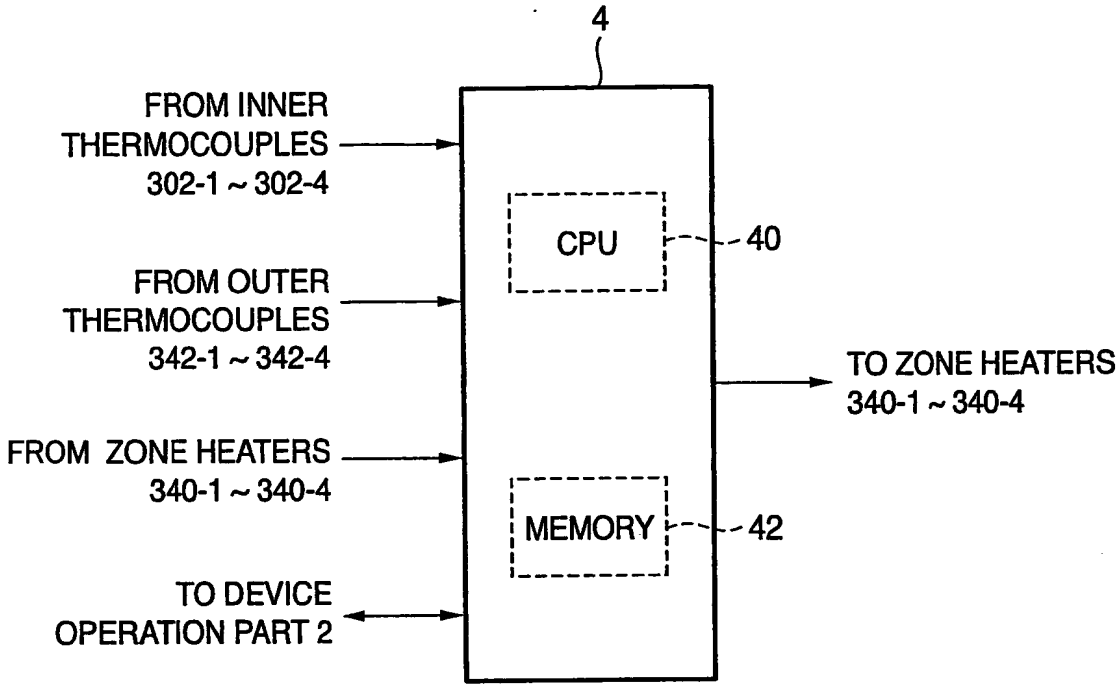

4
FROM INNER THERMOCOUPLES 302-1 ~ 302-4
FROM OUTER THERMOCOUPLES 342-1 ~ 342-4
FROM ZONE HEATERS 340-1 ~ 340-4
TO DEVICE OPERATION PART 2
CPU
40
MEMORY
42
TO ZONE HEATERS 340-1 ~ 340-4

FIG. 5

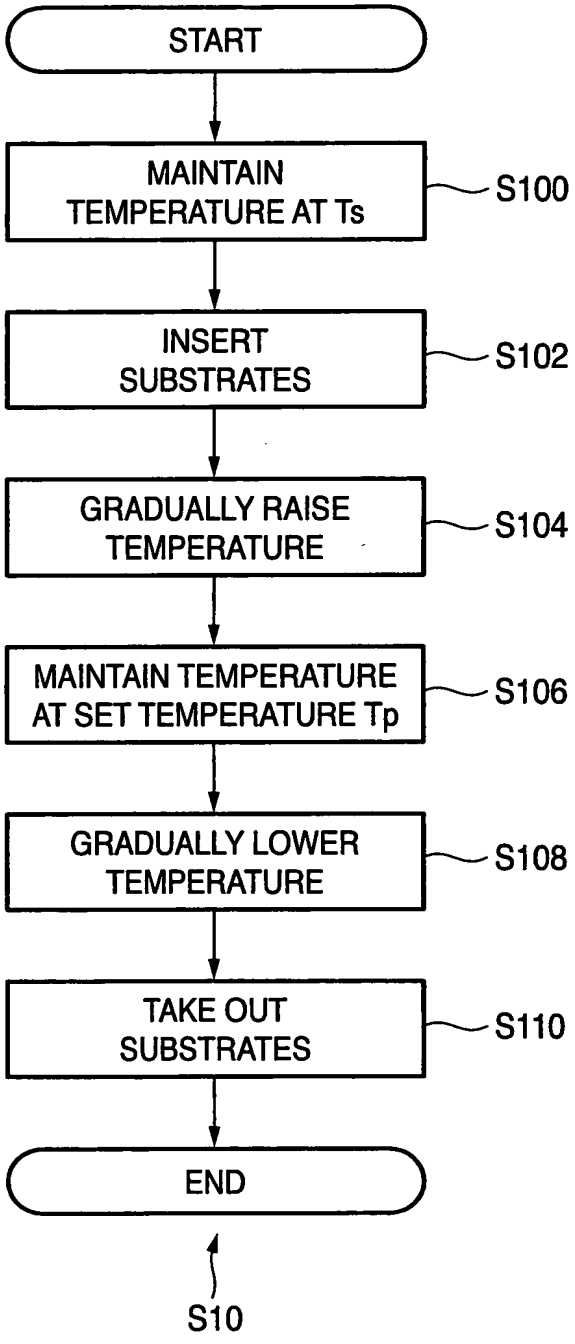

START
MAINTAIN TEMPERATURE AT Ts
S100
INSERT SUBSTRATES
S102
GRADUALLY RAISE TEMPERATURE
S104
MAINTAIN TEMPERATURE AT SET TEMPERATURE Tp
S106
GRADUALLY LOWER TEMPERATURE
S108
TAKE OUT SUBSTRATES
S110
END
S10

FIG. 6

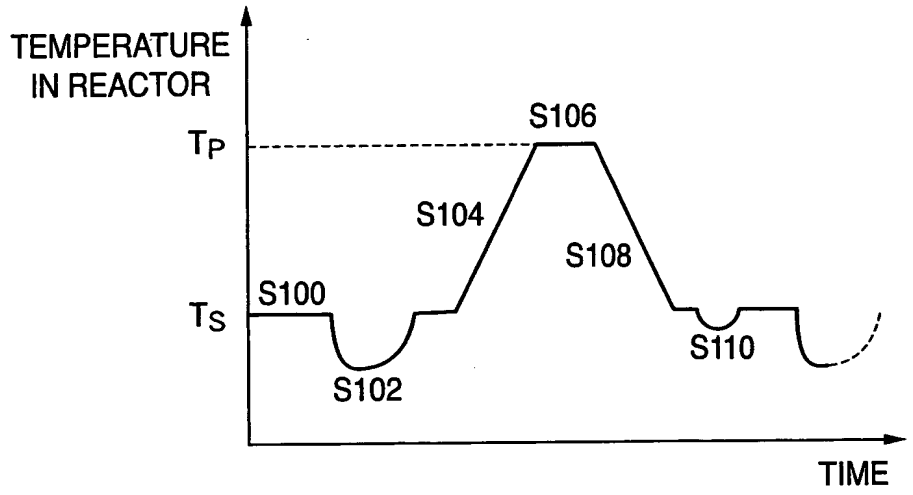

TEMPERATURE
IN REACTOR
T_P
T_S
S100
S102
S104
S106
S108
S110
TIME

FIG. 7

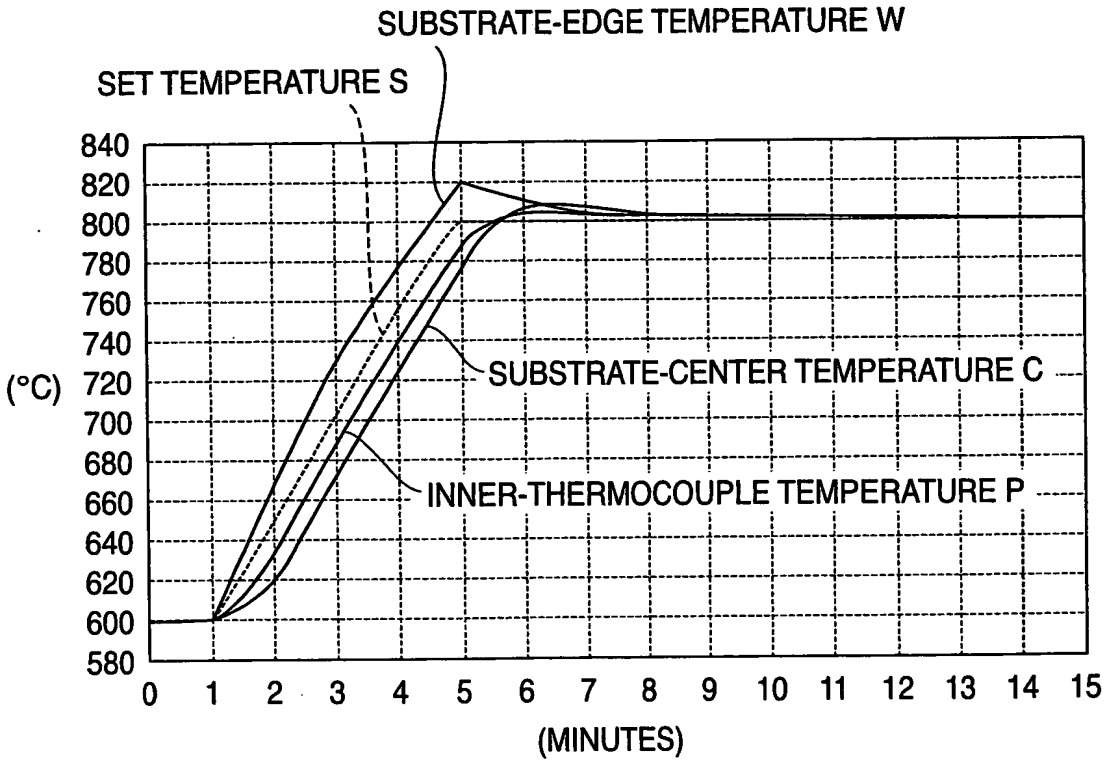

SUBSTRATE-EDGE TEMPERATURE W
SET TEMPERATURE S
SUBSTRATE-CENTER TEMPERATURE C
INNER-THERMOCOUPLE TEMPERATURE P
(°C)
840
820
800
780
760
740
720
700
680
660
640
620
600
580
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
(MINUTES)

FIG. 8

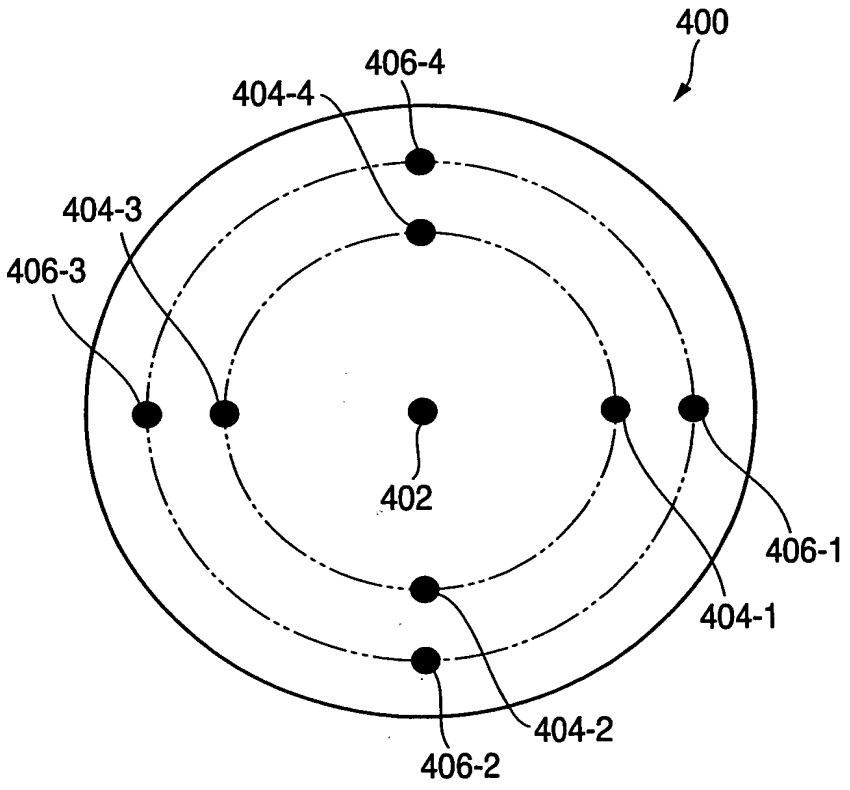


FIG. 9

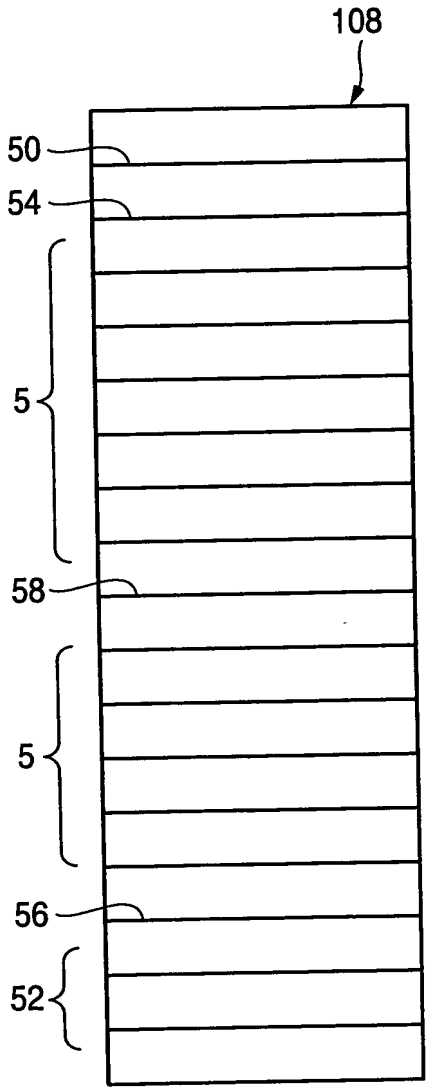


FIG. 10

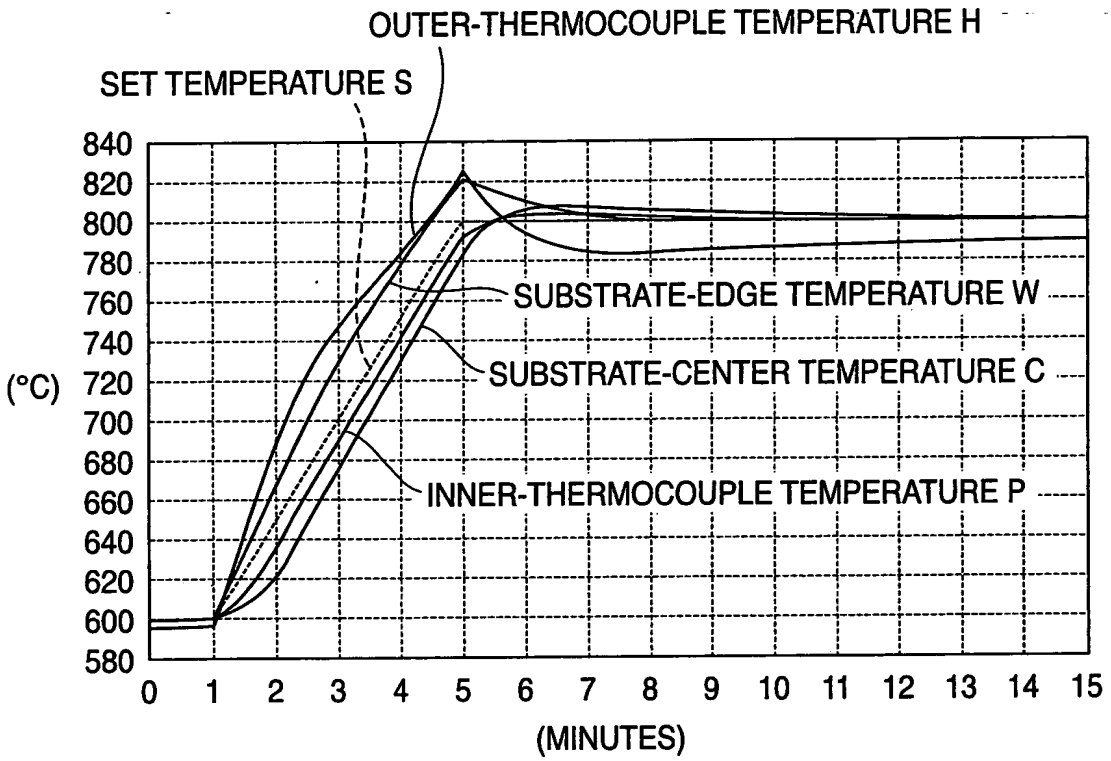


FIG. 11

	UPPER TEMPERATURE MONITOR	CENTRAL TEMPERATURE MONITOR	LOWER TEMPERATURE MONITOR
FLAT (WHEN STABLE)	852.4	853.0	853.6
U+5°C	855.6	852.7	853.2
CU+5°C	854.0	854.4	852.9
CL+5°C	852.1	857.0	855.7
L+5°C	852.3	852.6	856.7

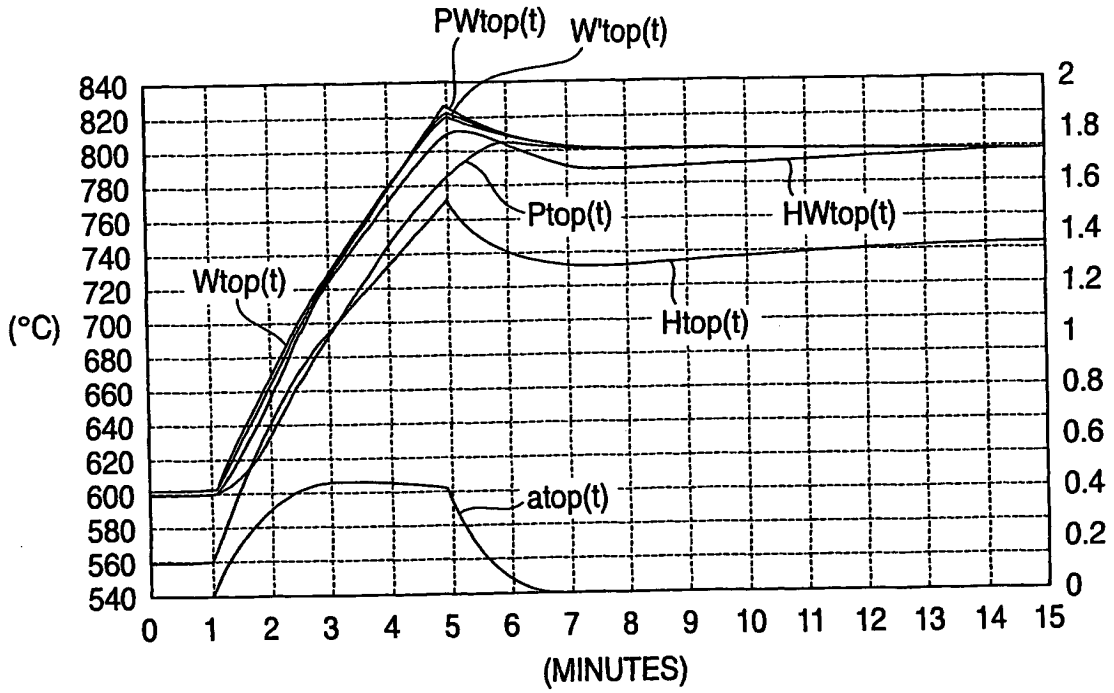
FIG. 12

VARIATION	UPPER TEMPERATURE MONITOR	CENTRAL TEMPERATURE MONITOR	LOWER TEMPERATURE MONITOR
U	3.2	-0.3	-0.4
CU	1.6	1.4	-0.7
CL	-0.3	4.0	2.1
L	-0.1	-0.4	3.1
SUM OF VARIATIONS	4.4	4.7	4.1

FIG. 13

RATE OF VARIATION	UPPER TEMPERATURE MONITOR	CENTRAL TEMPERATURE MONITOR	LOWER TEMPERATURE MONITOR
U	0.727	-0.064	-0.097
CU	0.364	0.298	-0.171
CL	-0.068	0.851	0.512
L	-0.023	-0.085	0.756
SUM	1.000	1.000	1.000

FIG. 14



TEMPERATURE PREDICTION PARAMETERS
(T1=50, K1=1.074, T2=12S, K2=1.072, b=40, C=1.0)

FIG. 15

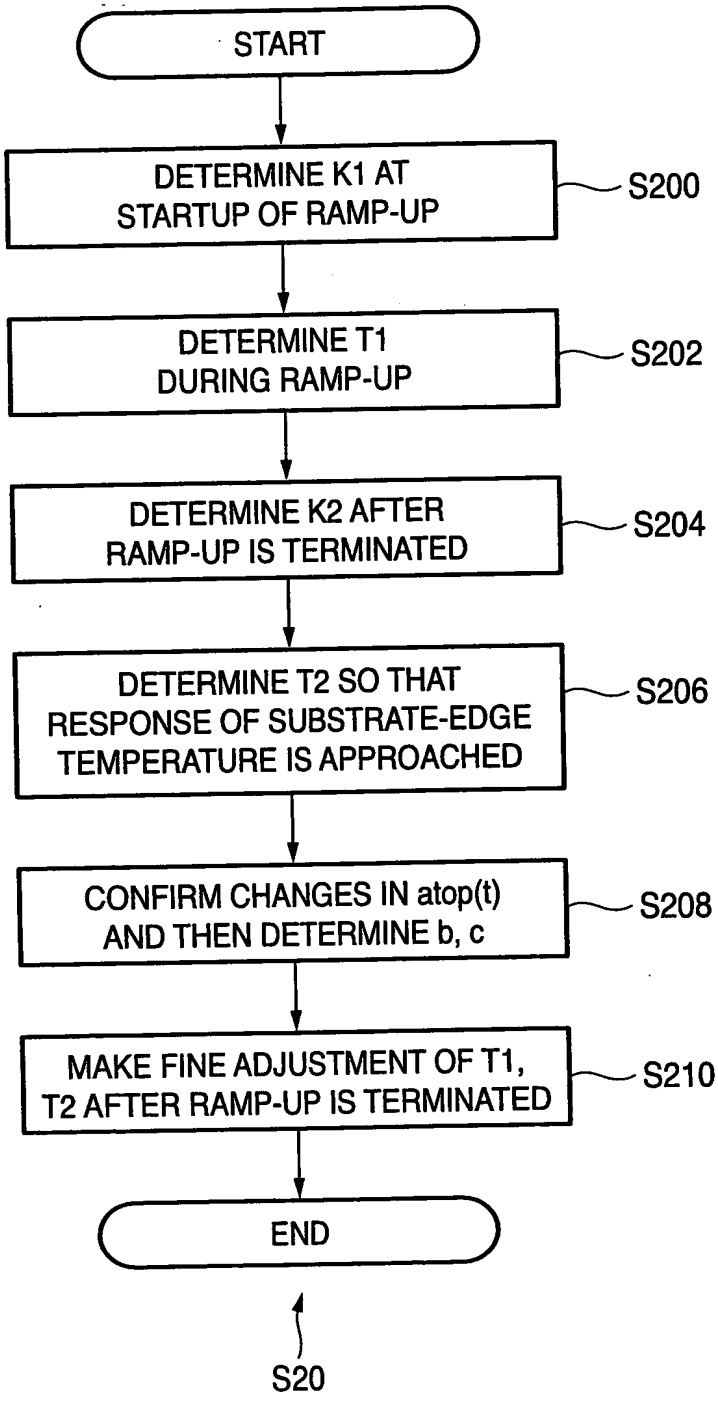

START
DETERMINE K1 AT STARTUP OF RAMP-UP
S200
DETERMINE T1 DURING RAMP-UP
S202
DETERMINE K2 AFTER RAMP-UP IS TERMINATED
S204
DETERMINE T2 SO THAT RESPONSE OF SUBSTRATE-EDGE TEMPERATURE IS APPROACHED
S206
CONFIRM CHANGES IN atop(t) AND THEN DETERMINE b, c
S208
MAKE FINE ADJUSTMENT OF T1, T2 AFTER RAMP-UP IS TERMINATED
S210
END
S20

FIG. 16

	U	CU	CL	L
UPPER TEMPERATURE MONITOR	0.640	0.320	-0.060	-0.020
CENTRAL TEMPERATURE MONITOR	-0.060	0.280	0.800	-0.080
LOWER TEMPERATURE MONITOR	-0.080	-0.140	0.420	0.620

FIG. 17

	U	CU	CL	L
VIRTUAL UPPER MONITOR SUBSTRATE	1.000	0.000	0.000	0.000
UPPER TEMPERATURE MONITOR	0.640	0.320	-0.060	-0.020
CENTRAL TEMPERATURE MONITOR	-0.060	0.280	0.800	-0.080
LOWER TEMPERATURE MONITOR	-0.080	-0.140	0.420	0.620

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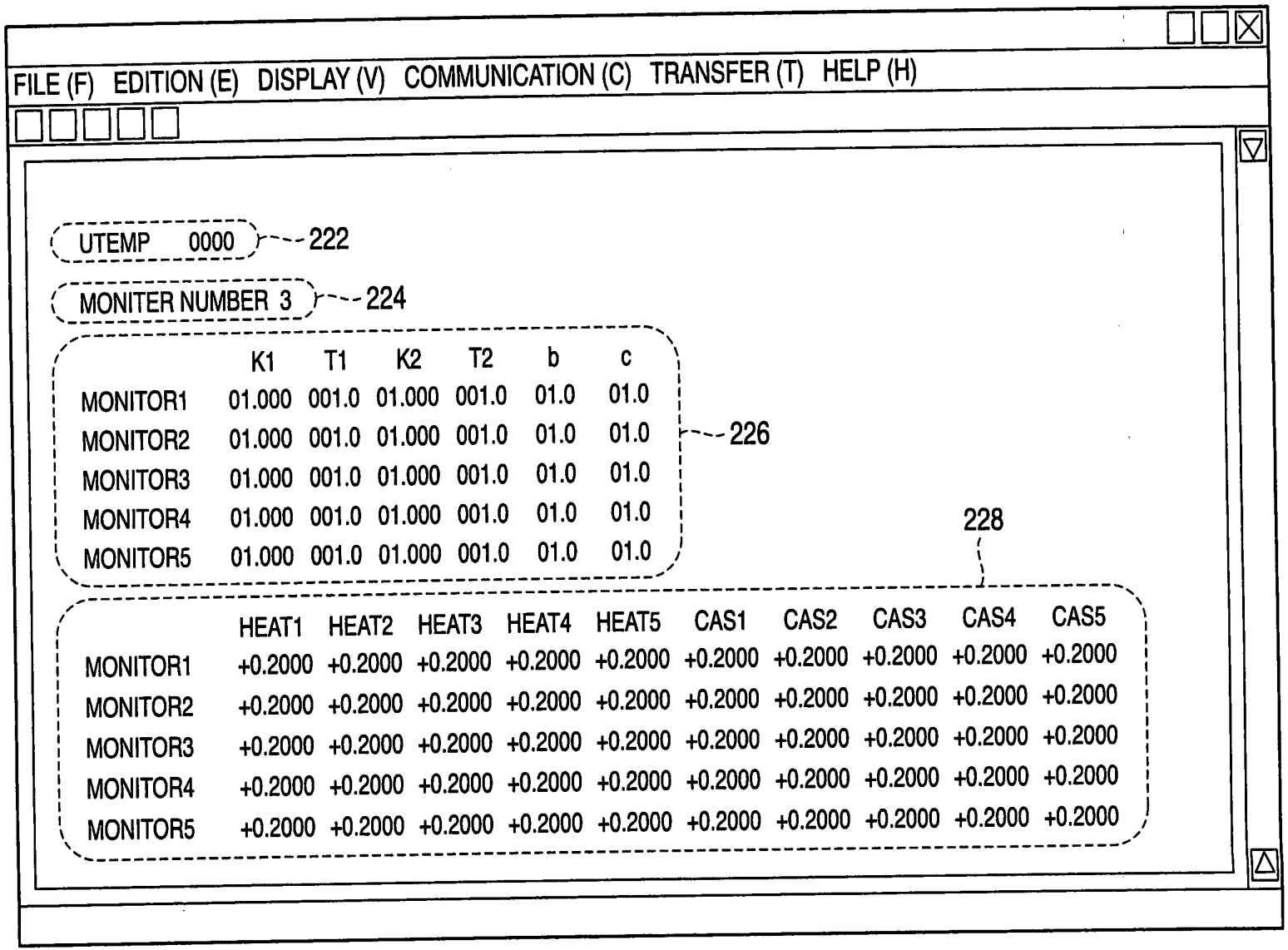
FIG. 18



	K1	T1	K2	T2	b	c
MONITOR1	01.000	001.0	01.000	001.0	01.0	01.0
MONITOR2	01.000	001.0	01.000	001.0	01.0	01.0
MONITOR3	01.000	001.0	01.000	001.0	01.0	01.0
MONITOR4	01.000	001.0	01.000	001.0	01.0	01.0
MONITOR5	01.000	001.0	01.000	001.0	01.0	01.0

	HEAT1	HEAT2	HEAT3	HEAT4	HEAT5	CAS1	CAS2	CAS3	CAS4	CAS5
MONITOR1	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000
MONITOR2	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000
MONITOR3	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000
MONITOR4	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000
MONITOR5	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000	+0.2000

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FIG. 19

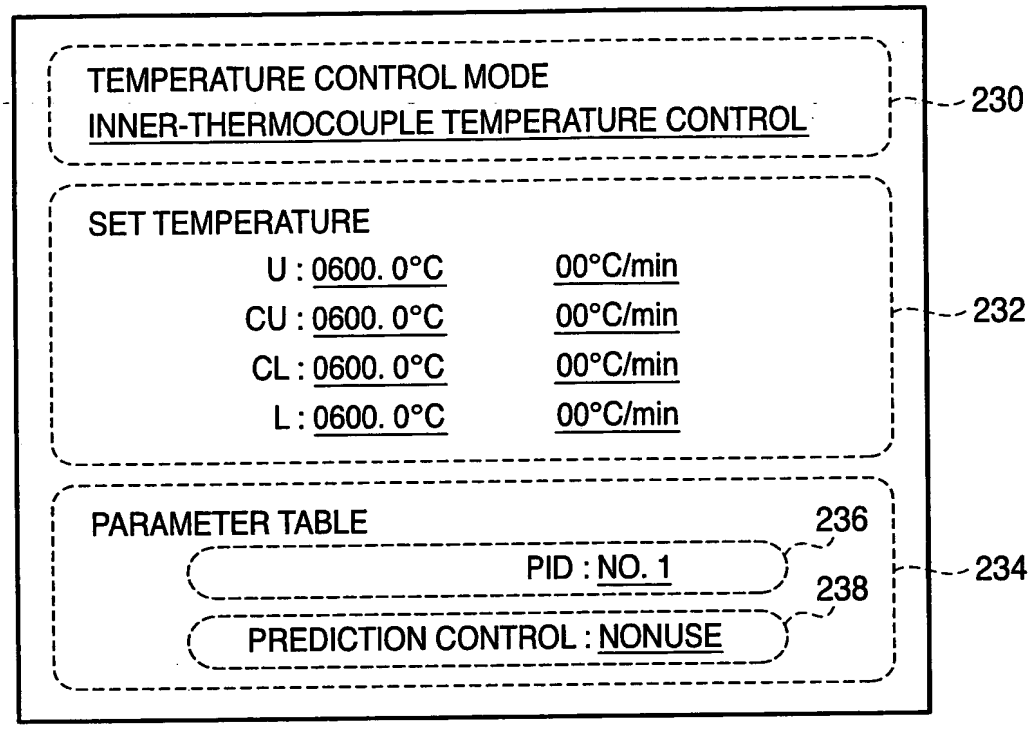

TEMPERATURE CONTROL MODE
INNER-THERMOCOUPLE TEMPERATURE CONTROL
230
SET TEMPERATURE
U : 0600. 0°C 00°C/min
CU : 0600. 0°C 00°C/min
CL : 0600. 0°C 00°C/min
L : 0600. 0°C 00°C/min
232
PARAMETER TABLE
236
PID : NO. 1
238
PREDICTION CONTROL : NONUSE
234

FIG. 20

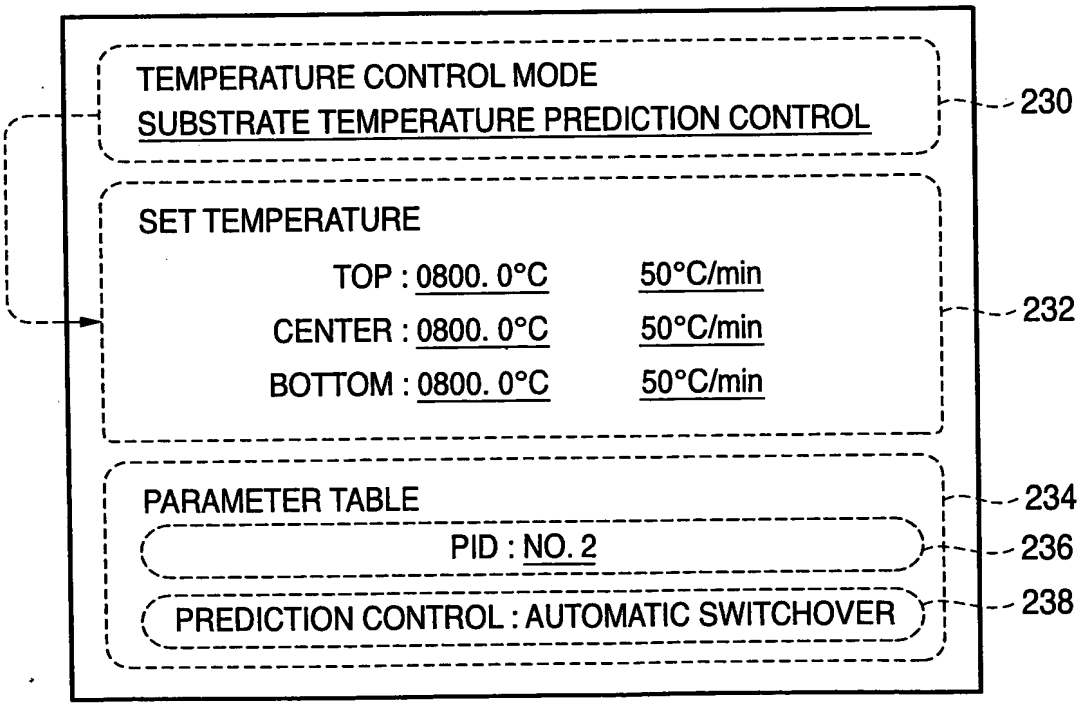

TEMPERATURE CONTROL MODE
SUBSTRATE TEMPERATURE PREDICTION CONTROL
230
SET TEMPERATURE
TOP : 0800. 0°C 50°C/min
CENTER : 0800. 0°C 50°C/min
BOTTOM : 0800. 0°C 50°C/min
232
PARAMETER TABLE
234
PID : NO. 2
236
PREDICTION CONTROL : AUTOMATIC SWITCHOVER
238

FIG. 21

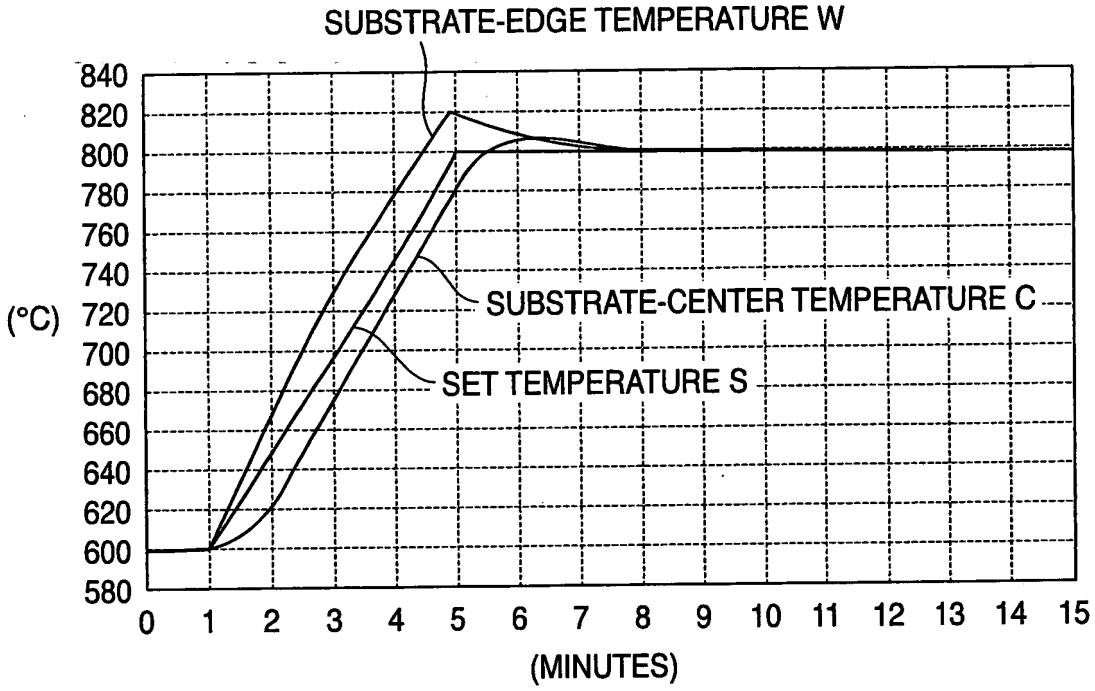

SUBSTRATE-EDGE TEMPERATURE W
SUBSTRATE-CENTER TEMPERATURE C
SET TEMPERATURE S
(°C)
840
820
800
780
760
740
720
700
680
660
640
620
600
580
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
(MINUTES)

FIG. 22

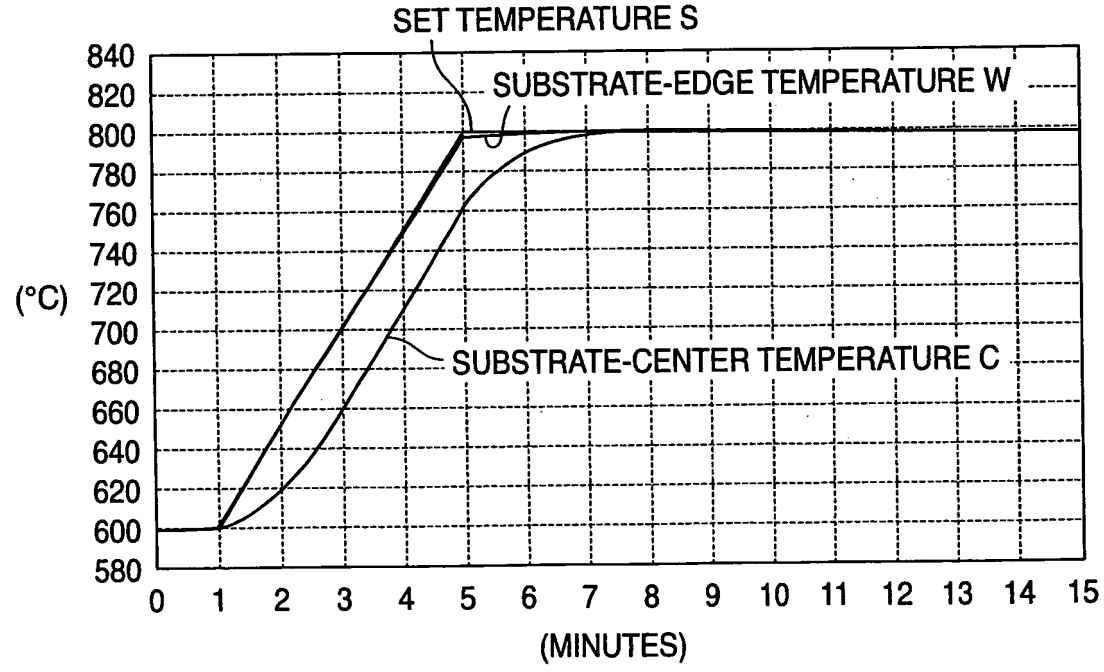
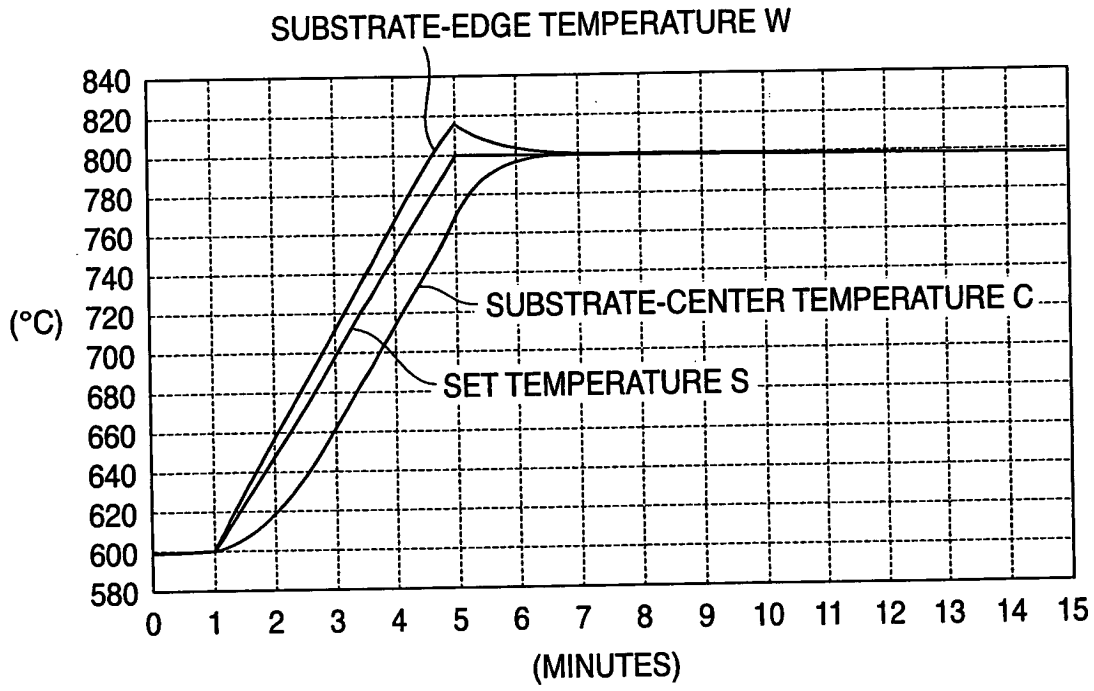

SET TEMPERATURE S
SUBSTRATE-EDGE TEMPERATURE W
SUBSTRATE-CENTER TEMPERATURE C
(°C)
840
820
800
780
760
740
720
700
680
660
640
620
600
580
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
(MINUTES)

FIG. 23


SUBSTRATE-EDGE TEMPERATURE W
SUBSTRATE-CENTER TEMPERATURE C
SET TEMPERATURE S
(°C)
840
820
800
780
760
740
720
700
680
660
640
620
600
580
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
(MINUTES)